Impact of Problem Representation on GA Performance: Point Scattering Problem

An investigation of the strengths and weaknesses of each problem representation

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Problem Representations

The point scattering problem is a mathematical problem that involves placing points on a unit circle such that the minimum distance between any two points is maximized. This report explores the impact of problem representation on GA performance on the point scattering problem by proposing three representations: point (x,y), point (x,y)’, and polar coordinates with theta. Each representation objective is to maximize said minimum distance between any pair of points to produce the maximum fitness evaluation.

1 Representation 1: Point (X, Y)

The first representation involves finding the optimal solution to a given set of points with the goal of arranging the points in sequential order. More formally, if it is expected that n points be placed on the unit circle, then the chromosome representing the coordinates of those points will be arranged as . Algorithmically it extends the fitness function to calculate the probability of finding the best arrangement of points (x,y) with random selection and fixed parameters where the cross rate is 1.0 and mutation rate is 0.01. Note that the probability that an x coordinate and its corresponding y coordinate are split during crossover is the following:

Figure 1: Representation 1, n=10

**Results.** The results of representation 1 showed that when n increases the fitness slightly decreases.

**Figure 1: Representation 1, n=25**

2 Representation 2: Point (X, Y)’

The second representation involves arranging the points with the x coordinates together and the y coordinates together. More formally, if n points are to be placed on the circle, then the chromosome representing the coordinates of those points is .

We used values of crossover and mutation of 1.0 and 0.01, respectively for this representation. The important difference between this representation and the first representation is that the probability that an x-coordinate is split with its corresponding y-coordinate during crossover is the following:

Figure 1: Representation 1, n=50

1.1 Representation 3:

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1.1 Representation 3: Polar Coordinates

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2. Right click on the inserted picture and select the **Format Picture** option.
3. In the settings at the right side of the window, click on the "Layout & Properties" icon (3rd option).

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